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ABSTRACT

The Management Systems Series consists of documents of interest to persons concerned with the management of public resources. Operation PEP (Prepare Educational Planners), which called for a three-day session of instruction on Executive (Management Information Systems) was documented in detail as part of this series. This portion attempts to describe the information system of a school district in the same way as it is currently viewed by the educational administrators themselves. It points out that how a system is seen or defined can have an effect on the development of a strategy for improvement of the system and offer an example of a structured reporting system, that of a responsibility accounting system. (AB)

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MANAGEMENT SYSTEMS SERIES/REPORT NO. 5

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M70-83

AN INFORMATION SYSTEM FOR AN EDUCATIONAL ADMINISTRATOR

S. G. Lewis

August 1970

This paper is based on a presentation especially prepared for those California Educational Administrators who participated in the "Executive Information Systems" Unit of Instruction. This Unit represented one portion of the instructional program of OPERATION PEP (Prepare Educational Planners).

This document has been prepared for public release.

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AN INFORMATION SYSTEM
FOR
AN EDUCATIONAL ADMINISTRATOR

FOREWORD TO THE MANAGEMENT SYSTEMS SERIES

The MITRE Corporation has been engaged for more than a decade in the development and implementation of large-scale, computer-based command and management systems. Such work has been accomplished for a number of organizations within the Department of Defense (principally the Air Force) and other federal agencies such as the Federal Aviation Administration (FAA) and the National Aeronautics and Space Agency (NASA). During recent years, MITRE has expanded its sphere of clients, applying its insights and capabilities to assisting non-defense agencies at all government levels --- federal, state and local --- improve their management systems.

The Management Systems Series (MSS) consists of documents describing the results of these recent efforts --- documents considered to be of general interest to persons, both practitioners and researchers, concerned with the management of public resources. Current and planned documents cover a wide range of topics, both technical and practical, associated with the development and improvement of such systems for users in, for example, public administration, education, public health, and justice agencies. The purpose of publishing this series is to underscore the many factors to be weighed in designing or improving a management system, some of which do not directly involve the computer, but all of which significantly impact on the system as a whole. Fulfillment of this purpose will broaden management's perception of its system.

PREFACE

Operation PEP* (Prepare Educational Planners), through the San Mateo County (California) Superintendent of Schools, awarded two contracts to The MITRE Corporation's Information Systems Division between 1968 and 1970. The first called for the preparation of a three-day Unit of Instruction on Executive (Management) Information Systems designed to uncover, for more than 100 California Educational Administrators of varying backgrounds and interests, some basic concepts relating to information systems technology.

In order to establish profiles of the audience's knowledge of and specific interests in information systems technology, MITRE developed and mailed a sampling instrument to prospective participants before designing the course. Answers to the highly structured questions were tabulated and translated into scatter diagrams and graphs. The results validated anticipations regarding knowledge of information systems: the majority of the respondents indicated limited familiarity with such systems in general, with a few espousing either specific and detailed knowledge or almost not understanding. And even those who claimed extensive knowledge admitted to doubt in understanding how such systems related to the needs and problems of the educational administrator and his organization. Most significantly, perhaps, the results unequivocally confirmed that the respondents were first and foremost *managers* and thus were interested in aspects of information systems technology that related more to behavioral than to information sciences.

The audience's orientation impacted strongly on the final design of the contents of the Unit of Instruction presented in June 1968. Basic concepts of computer hardware and software were balanced by subjects such as organizational problem-finding and problems of introducing change, topics inextricably interwoven with the design, development and implementation of computer-based management

*Operation PEP was funded by a U.S. Office of Education Grant Award under Title III of the Elementary and Secondary Education Act of 1965 (P.L. 89-10).

information systems. Despite their importance, such subjects often are neglected; the cost of such neglect often exceeds many times over the cost of the information system per se.

Favorable audience reaction to the Unit of Instruction led to the second contract award which called for the detailed documentation of the concepts and aspects uncovered during the three-day session. The resulting reports have been published and distributed by Operation PEP to its participants. Because their contents have applicability to the problems faced by managers in other government agencies – managers who now are or soon will be involved in acquiring and introducing information systems into their organizations – these reports (see listing below) have also been published by The MITRE Corporation as part of its Management Systems Series (MSS).

Unit of Instruction Reports

Information System Overview	J. H. Burrows	MSS Report No. 1 (MITRE Report No. M70-80)
The State-of-the-Art in Information Handling	J. K. Summers and J. E. Sullivan	MSS Report No. 2 (MITRE Report No. M70-81)
A Framework for the Evolutionary Development of an Executive Information System (in two parts)	J. A. Evans	
Part 1. Organizational Problem Finding		MSS Report No. 3 (MITRE Report No. M70-82)
Part 2. Overview of MIS Design and Implementation Efforts		MSS Report No. 4 (MITRE Report No. M70-82)
An Information System for an Educational Administrator	S. G. Lewis	MSS Report No. 5 (MITRE Report No. 70-83)
Persistent Problems in System Development	J. H. Burrows	MSS Report No. 6 (MITRE Report No. 70-90)

This portion of the Unit of Instruction on Executive Information Systems has three main purposes:

first, it attempts to describe the information system of a school district in the same way as it is currently viewed by the educational administrators themselves;

second, it offers another way of viewing the district's information system, and suggests that how the system is seen or defined can have an important effect on the development of a strategy for improvement of the system; and

third, it offers an example of a structured reporting system – a responsibility accounting system – which illustrates a direction for system improvement.

In order to achieve the above three purposes, the presentation was designed and conducted as a simulation of a district-level meeting as opposed to, say,

a meeting of a single school. It was attended by the Superintendent of Schools, Assistant Superintendent, and the Chairman of the School Board. The meeting was called to review the first monthly progress briefing by a consultant assigned to a special four-month study on the feasibility of introducing an "information system" to the school district.

The scenario included the following assumptions. The district already has a small, first-generation card processing computer which performs many routine data processing tasks. The Superintendent is not at all sure that this capability will be adequate to assist him in carrying out future tasks. A consultant retained to study the situation and make proposals and recommendations on what actions should be taken has completed one month of the four-month total study. The Superintendent has specifically asked the consultant to report on three matters: first, progress to date; second, the difference between an information system and his present data processing capability; and third, an indication of the direction in which the district should be heading to improve its information support system.

Although it was intended that this meeting simulate a real situation, a number of factors limit the degree of realism. Among these are the following two: first is the amount of detail treated in the report. Some of the material presented is based on a composite of a number of school districts. Detailed characteristics of a particular district, which normally would be highlighted, have been omitted. Second is the nature of the plans and strategy. In a real situation these would be quite specific; here they are stated in general terms since the realities of a specific district environment cannot be accurately replicated.

The material contained in this report is based on the dialogue and exchange of views that occurred during the actual presentation.

EXECUTIVE INFORMATION SYSTEMS	A SYSTEM FOR EDUCATIONAL ADMINISTRATION

- **FINDINGS TO DATE**

  CURRENT INFORMATION SYSTEM

  IMPROVEMENT STRATEGY

- **INFORMATION SYSTEM DIMENSIONS**

- **PROBLEMS**

  INFORMATION SYSTEM

  OTHERS

- **WHERE DO WE GO FROM HERE**

In general, the report is structured along the lines of the purposes stated on page one. First, the user's (in this case, the Superintendent) view of his information system is described in terms familiar to him, namely, in data processing applications terms, along with a review of what appears to be his strategy *for* system improvement. Next, a more broadly defined view of the district's information system is shown in terms of key information system dimensions. Then, certain problems are discussed which would normally be addressed by any system improvement program. Finally, the factors necessary to arrive at a new strategy are discussed, and an illustrative example of a structured reporting system is shown to offer a more meaningful view of what the information system can do to improve the administration of the district.

EXECUTIVE INFORMATION SYSTEMS	A SYSTEM FOR EDUCATIONAL ADMINISTRATION

CURRENT APPLICATIONS

1. STUDENT SCHEDULING
2. PERMANENT RECORD LABELS
3. HONOR ROLL
4. HOME ADDRESS LABELS
5. CAFETERIA PAYROLL
6. REVENUE LEDGER
7. PERIODICAL INVENTORY
8.
9.
-
-
-

Achievement of the first purpose begins by answering the question: how is the current "information system" viewed by the administrators of the school district? – the people who are served by the system and who are responsible for deciding future capabilities of the system. The fact is that most educational administrators, if they have automated data processing applications, tend to view their information system in terms of these applications (see facing chart).

It should be noted that this view certainly is not unique to educational administrators. This orientation is prevalent in most other fields because until one sees it in operation in a familiar environment, the concept of an information system is virtually meaningless. Its functions are easy to identify: what an information system does is to acquire, process and communicate information, but until one can visualize what the information is used for – and how difficult, or impossible, it has been or is to get that information – the benefits of that system cannot be readily appreciated.

In his environment, the educational administrator visualizes an information system in terms of data processing applications such as student scheduling, permanent record labels, honor roll list, home address labels, and so on. A given school district may have from 100 to 300 such data processing applications, ranging from very simple procedures, such as those required to print mailing labels, to more complex ones, such as those involved in the production of a payroll and supporting records. In many cases, the term data processing application is used as a synonym for a report (or product). For example, the honor roll application is the same as the honor roll list, and the home address label application is the same as the list of labels. In other cases, the data processing applications are defined in terms of an administrative function: for example, student scheduling.

This view of the information system is unsatisfactory. The perspective is narrow, and tends to exclude the peripheral aspects (for example, data acquisition and data use) of the system. While the educational administrator does tend to relate his data processing applications to information flow, he does so in a limited way. Usually he focuses on what happens in and around the computer (data processing and storage), failing to give proper weight to sources of and the form in which data are acquired as well as who will need what data and how often. The perspective also tends to obscure the possibility of two or more data processing applications sharing the same data sources. More significantly, it tends to encourage "application ownership": that is, the person who receives the output reports views himself as the "owner" of the data processing application that produces it. Application ownership can do much to prevent application integration and orderly system growth. Finally, this view ignores non-automated information system applications – and these may be more important, from both a cost and utility standpoint, than the applications currently receiving automated support.

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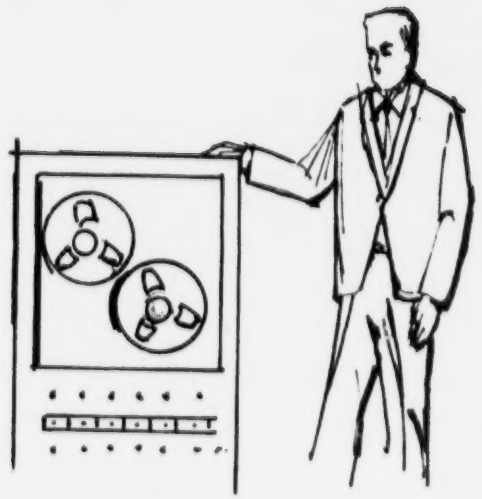
EXECUTIVE INFORMATION SYSTEMS	A SYSTEM FOR EDUCATIONAL ADMINISTRATION

CURRENT FORMAL SEGMENTS

- PAYROLL
- ACCOUNTS PAYABLE
- OTHER ACCOUNTING
- STUDENT ACCOUNTING



ATTENDANCE
CENSUS
GRADE REPORTING
REGISTRATION & SCHEDULING
GENERATING PERMANENT RECORDS
TESTING

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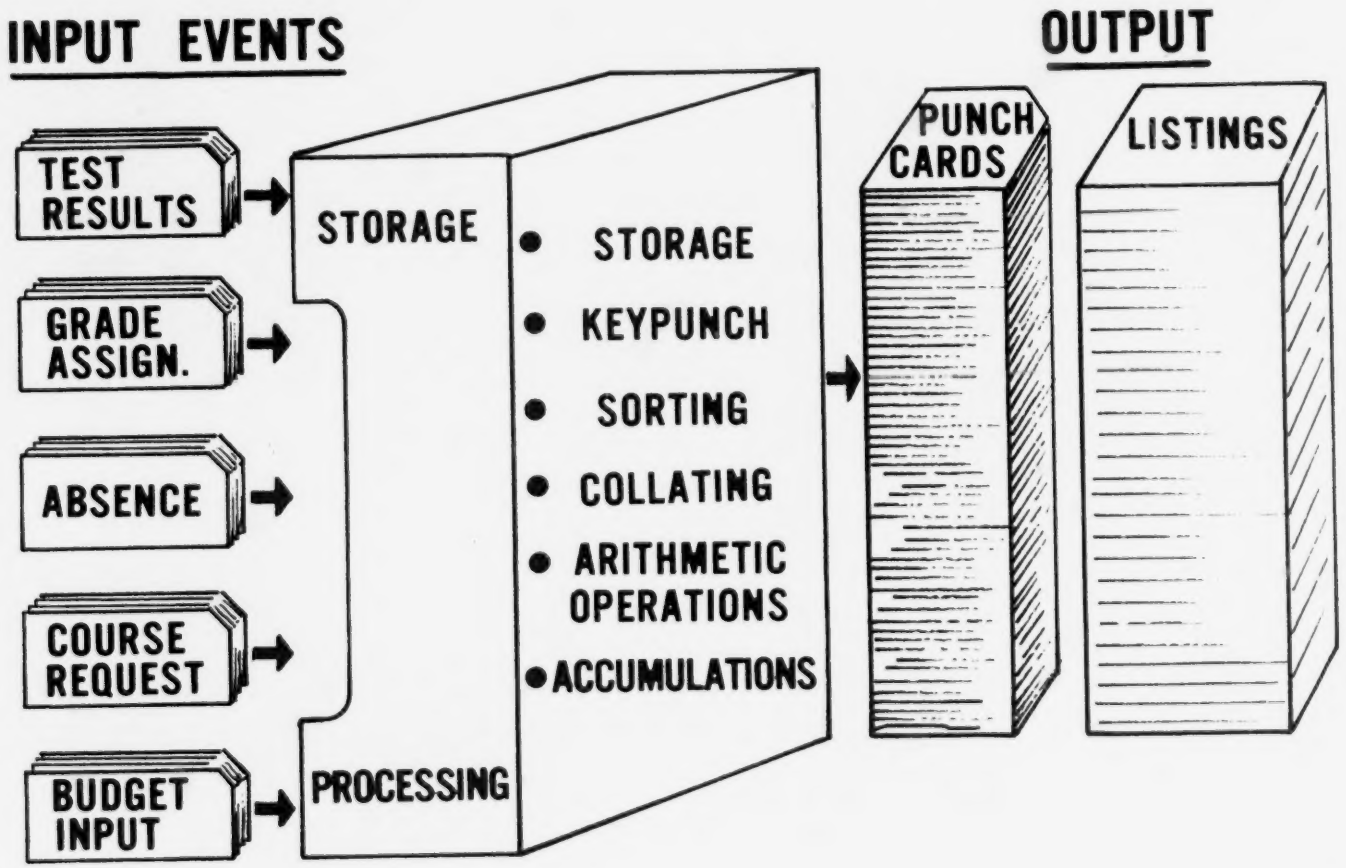
In some cases, the educational administrator views his information system in terms of larger aggregations or "application areas": that is, system segments or subsystems such as payroll, accounts payable, and student accounting. He may even, as a first aggregation, define some of the types of data relevant to each system segment. Although such a view is a step toward defining the system as a set of larger elements, and as such can encourage consideration of data sharing across applications, it still represents a narrow system perspective, tending to ignore non-automated information system "applications."

EXECUTIVE INFORMATION SYSTEMS	A SYSTEM FOR EDUCATIONAL ADMINISTRATION

CURRENT APPLICATIONS - INFORMATION FLOWS



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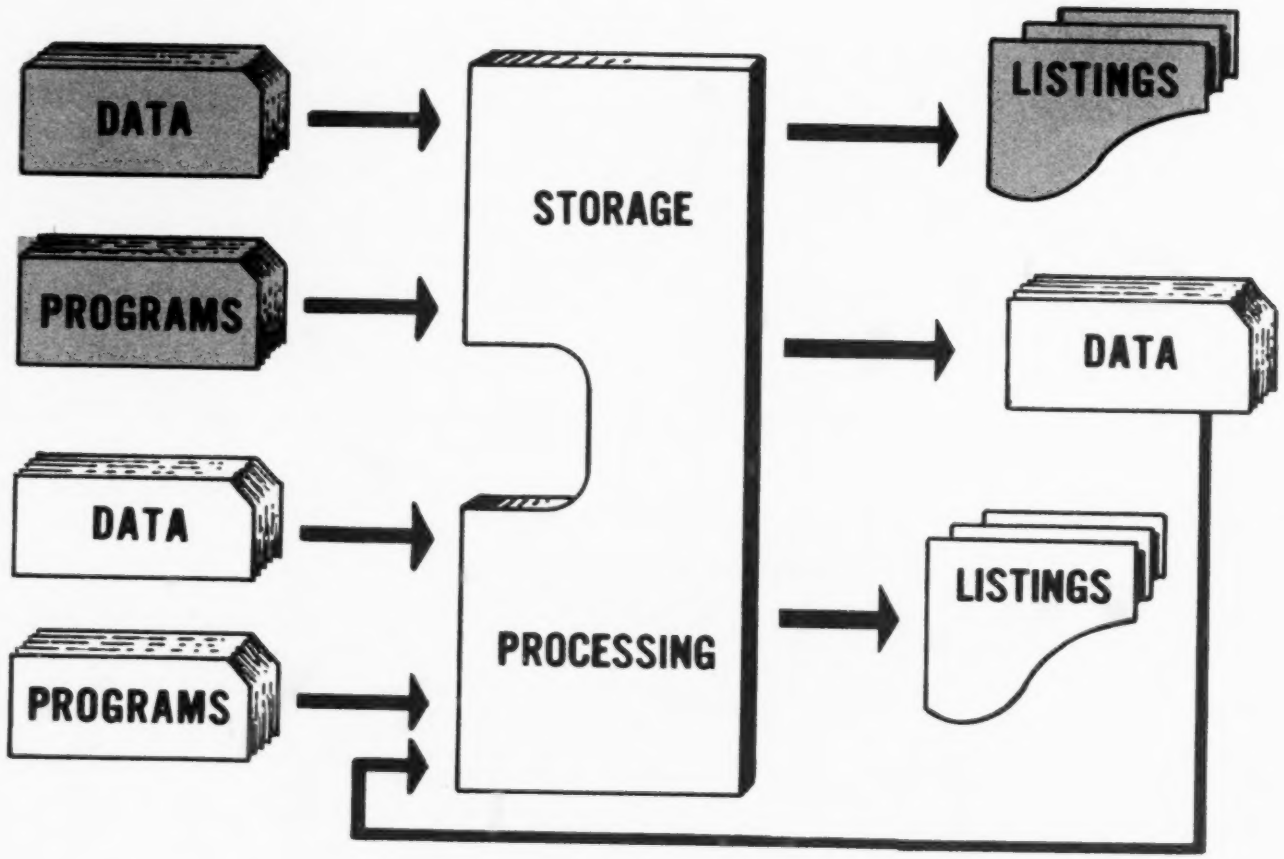
At times the educational administrator views his data processing applications in terms of basic computer devices, i.e., input and output, and units, i.e., storage and processing. In so doing, he evidences a gross realization of how information flows in and around the computer. For him, information flow begins when punched cards containing data for items such as test results, grade assignments, and course requests enter the input device and are processed. It ends with the generation of outputs — either another set of punched cards or listings (see opposite chart). As before, he tends to exclude the two extremes — data acquisition and data use — from his concept of the information flow stream.

The importance of considering both ends of the stream cannot be overstressed. At the input end are data acquisition processes which can represent a relatively large investment. Needless redundancy adds to the operational costs. When two or more data processing applications — for example, the test results and grade assignment applications —— require as an input the same list of students, it should not be necessary to compile such data separately for each application. At the other end of the stream — data use — we find that the data processing application frequently accomplishes only a part of the total job necessary to convert the data into the exact form required for use: for example, the computer may be programmed to produce a list of people by age when what is really needed — and will later be produced manually and at substantial expense — is a frequency histogram.

The importance of gaining a more balanced perspective in regard to information systems relates to the nature of such systems: they are always changing and growing. <u>The way in which change and growth takes place is directly affected by the way a user views his system</u>.

EXECUTIVE INFORMATION SYSTEMS	A SYSTEM FOR EDUCATIONAL ADMINISTRATION

LINEAR CONSOLIDATION



It is natural for the educational administrator to think of implementing system growth and improvement in one or more of the following three ways:

(1) by adding new, independent data processing applications;

(2) through linear consolidation of some programs or outputs; or

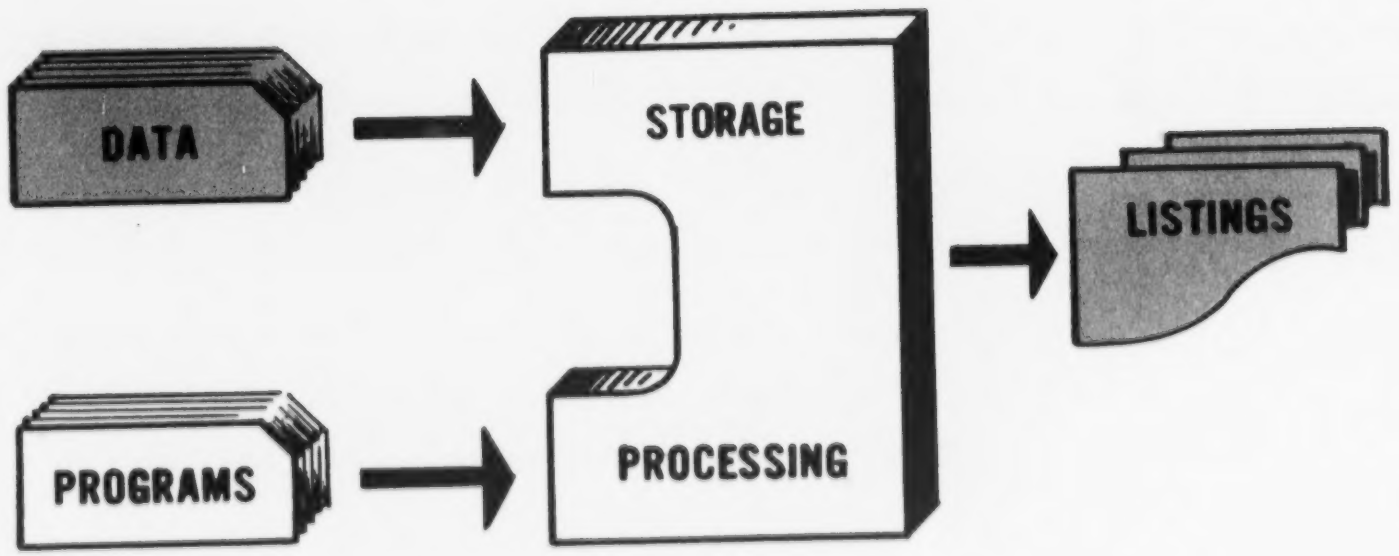
(3) by merging some of the programs or outputs.

The addition of new data processing applications is a simple concept and is not discussed herein. The second and third approaches represents two methods of consolidation.

The opposite chart depicts the second method of system improvement or growth – linear consolidation. The two data processing applications shown, (screened and unscreened boxes at left) each contain data and program inputs and each produce an output listing. Linear consolidation is achieved by changing the (screened) program, thereby producing another set of data (right) which, in turn, is fed into the lower (unscreened) data processing application. This results in a more useful output (listing). This form of consolidation usually is repeated until a long string of interrelated data processing applications is formed. An example of linear consolidation is the feeding of certain payroll application outputs into a general accounting application.

EXECUTIVE INFORMATION SYSTEMS	A SYSTEM FOR EDUCATIONAL ADMINISTRATION

MERGER



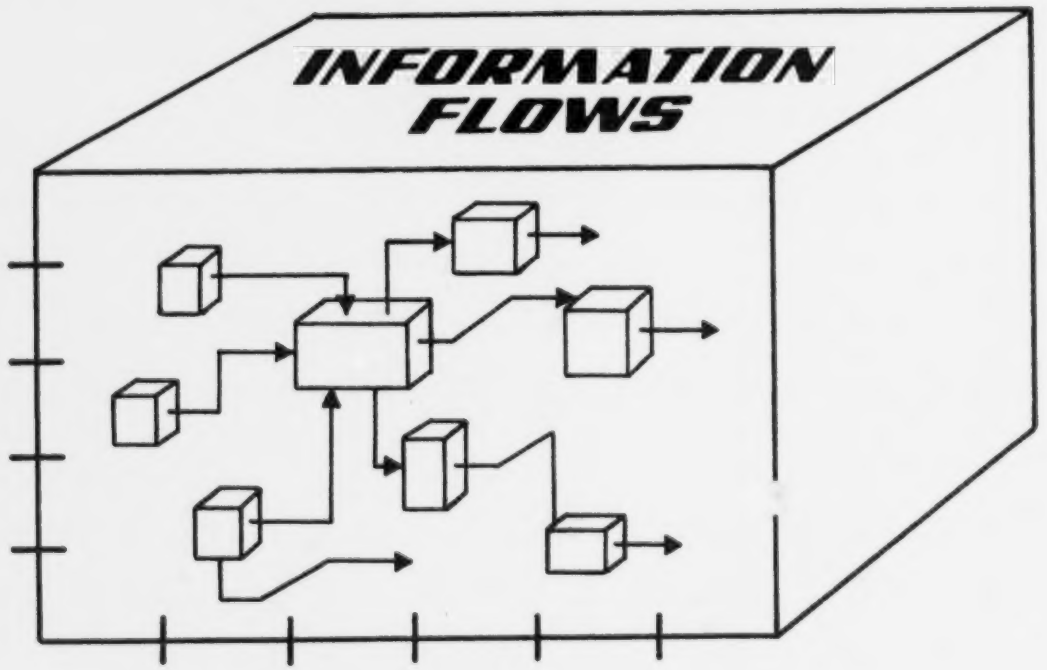
The third method of achieving system improvement or growth can be realized through another consolidation technique, the merging of two closely related data processing applications. By various reprogramming means, two inventory applications, for example, can be processed together as one. Or two payroll applications, one for certificated employees and one for classified employees, can be merged into a single payroll system.

Either form of consolidation, linear or merger, presents problems. One is that reprogramming is usually necessary and, in some cases, the data processing applications must be completely redesigned. Another problem – and perhaps a potentially more serious one – is that the applications to be consolidated usually are not either analyzed to see what each really does accomplish or assessed to determine what each should accomplish.

This concludes the discussion of the information system perspective currently held by the educational administrators. We have tried to describe his system in terms familiar to him, and characterize his understanding of his current system and the ways in which he would tend to change or expand it. We are ready now to proceed to the second purpose of this presentation, the discussion of another way of viewing the district's information system.

EXECUTIVE INFORMATION SYSTEMS	A SYSTEM FOR EDUCATIONAL ADMINISTRATION

DIMENSIONS OF INFORMATION SYSTEM STRUCTURE



The second purpose of this presentation is to arrive at another way – or other ways – of viewing an information system. We would like these perspectives to be more useful to us (1) in assessing the contribution of the system to the effective administration of the district, and (2) in suggesting a wider range of possibilities for improvement strategies.

Generally speaking, an information system structure can be defined in terms of the three dimensions shown in the facing illustration: (1) major functions according to system segments or subsystems, (2) data base segments or files, and (3) comprehensive information flows.

The first dimension, major functions, will be discussed as two options. The first considers that the structure of the segments or subsystems of an information system will closely parallel the major organizational units of a district. The second option looks at what these units actually do – the jobs or tasks each must perform – and uses "decision areas" as the basis for the information system's structure.

The second dimension, data base segments, focuses on how the data of the organization are structured and used in meeting the needs established by the functions or subsystems.

The third information system dimension, the flow of information, includes data acquisition and data use – aspects usually neglected by the user in defining his system.

EXECUTIVE INFORMATION SYSTEMS	A SYSTEM FOR EDUCATIONAL ADMINISTRATION

SYSTEM SEGMENTS - OPTION A

PLANNING, CONTROL AND EVALUATION	PERSONNEL	EDUCATIONAL	OPERATIONS	FINANCIAL
CURRICULUM	RECRUITMENT	I.M.	MAINT.	ACCNT'G.
FINANCIAL	TESTING	PUPIL-PERS.	CONSTR.	PAYROLL
FACILITIES	EVALUATION	CURRICULUM	TRANSP.	PURCH.
TRANSPORTATION	ASSIGNMENT	LIBRARY	CAFETERIA	PAYABLES
PERSONNEL	EDUCATION	PROGRAMS	INVENTORIES	
	ORIENTATION			

One way to structure system segments is to define them to be coterminous with major organizational units. For a school district, information system segments could be, for example:

- Planning, Control, and Evaluation
- Personnel
- Education
- Operations
- Financial
- Research (not shown in facing chart)

Data processing applications identified under the planning, control, and evaluation segment represent organizational planning elements or subjects such as financial plans, facilities plans, and personnel plans. Under personnel segment, the data processing applications correspond to stages in the personnel process, from recruitment through assignment and in-service training. The educational segment

is subdivided into the educational elements such as instructional materials, educational programs, and pupils. The operations segment is subdivided into the operations elements such as maintenance, cafeterias, and inventories. The information system segment labelled financial shows a more or less standard financial system breakout.

Defining the over-all information system of the district in this way has some distinct advantages. District people are familiar with these categories; it is easy for them to understand the boundaries and interrelationships. People have a sense of "belonging" to organizational units, and aligning the system along organizational lines helps to make the information system, that is, the formal definition and structure of the information system, a part of their daily life. They can feed it data and benefit from the outputs.

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The major disadvantage of structuring the information system along these lines is that a thorough review of the information requirements in the district usually is overlooked. A number of applications use exactly the same data: for example, pupil data is used in all aspects of planning, in operations, and in educational applications. Furthermore, setting up the information system applications along organizational lines tends to discourage data sharing. Another disadvantage stems from the fact that a number of data processing applications must be used together in a given decision process, such as resource allocation. Grouping these according to, say, management needs and use, would contribute to the development of a more effective system. This type of system segmentation is shown next, in Option B.

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EXECUTIVE INFORMATION SYSTEMS | A SYSTEM FOR EDUCATIONAL ADMINISTRATION

SYSTEM SEGMENTS - OPTION B

PLANNING	PUPIL EVALUATION/ GUIDANCE	RESOURCE ALLOCATION/ SCHEDULING	PROGRAM CONTROL/ EVALUATION	ADMIN. SUPPORT
PROGRAMS	PUPIL-PERS.	PERSONNEL	PROGRAMS	PAYROLL
PUPIL CENSUS	COLLEGE DATA	SCHEDULING	INST. MAT'L	CAFETERIA
BUDGET	TEST RESULTS	FACILITIES	ACCNTG.	INVENTORIES
FACILITIES PLANS	GRADE REPORTING		CONTROL REPORTS	LIBRARY
COMMUNITY CHAR.	EMPLOY. ENVIRON.			PURCH.
OTHER SCHOOL SYSTEMS				EXTERNAL REPORTS
FUND SOURCES				

An alternative method of segmenting the district's information system is shown on the facing page. The system segments are grouped according to jobs or tasks about which decisions must be made (i.e., decision areas). This structure is obtained by forming an idealized concept of the school district, in terms of what is really taking place, and what information is necessary to support the decisions made for the various jobs.

This approach was used by United Airlines in defining their requirements for a major information system development program. Four major subsystems were identified Market Evaluation, Long-Range Planning, Production Scheduling, and Production Control. All the information system's data processing applications were integrated into these segments.

The structure shown opposite is not dissimilar to the United Airlines concept. Five major decision areas are emphasized and the types of information necessary to arrive at and support the decisions identified.

- Planning: included are all aspects which must be considered and evaluated when planning for a time horizon of one year or more. Added to the more customary elements considered — programs and facilities — is information on

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the budget process, fund sources, community characteristics, pupil census, and on other school systems (for comparison purposes) because such aspects are of major importance in planning.*

- Pupil Evaluation and Guidance: required is information to aid in evaluating individuals in order to guide their transition from the school district environment to either a college or employment environment.

- Resource Allocation and Scheduling: included are the types of information needed to support the decision processes involved in allocating critical personnel and facility resources to district programs.

- Program Control and Evaluation: in contrast to the pupil evaluation system segment where emphasis is on the individual pupil this segment focuses on school programs, and the information required will consist of economic and performance data for control and evaluation.

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*In order to provide another perspective for understanding the role of the computer (and a formal information system) in the planning process, a chart is included (see pages 28 and 29) to identify some of the educational planning problems amenable to computer support.

- Administrative Support: this segment serves as a catch-all for individual data processing applications of a general administrative nature which are not specifically established for one of the other decision areas.

This information system structure emphasizes the activities of the management and top administrative personnel in terms of decisions, not how people are organized. (One cannot help but wonder if the approach to the organization and management of information should not differ from the way people are organized and managed.)

The primary advantage of this information system organization concept is that it focuses on decisions, the prime justification for information systems. A design based on this concept would require – would in all probability force – a thorough examination of what decisions must be made (and in what order) and what information is needed to support them. The primary disadvantage, of course, is that the organization's personnel will be unfamiliar with the new structure.

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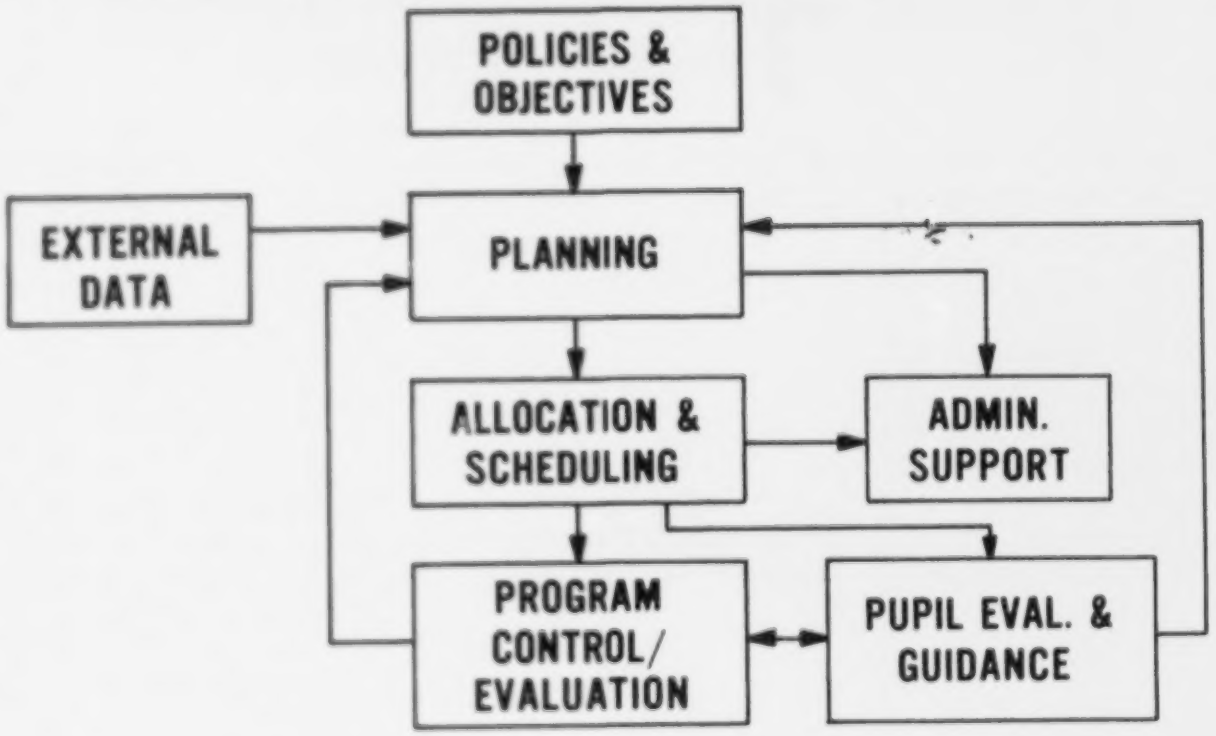
PROBLEMS IN EDUCATIONAL PLANNING
APPROPRIATE FOR COMPUTER SUPPORT*

LEVEL 1 Raw Data	LEVEL 2 Relationships Among Data	LEVEL 3 Decisions and Research
	GENERAL POLICY	
Codification and systemization of school laws, sources of funds, health and safety regulations, etc.	Effect of new policies on school health and safety records	Study of relationships between policies and teacher and student effectiveness
Results of polls on citizen expectation for schools	Patterns of relationships between sub-publics and types of expectation for schools	
	Relationships among types of administrative problems and processes used in decision-making	Conceptualization of possible new relationships and simulation of the consequences of effecting these relationships administratively
	FACULTY, STAFF AND STUDENTS	
Comprehensive inventories of teacher backgrounds	Relationships between age, institution attended, credentials, etc., and teacher retention in the system	
Long-term collections of data on student achievement, attendence, health, drop-out, etc.	Relationships between school achievement and student health	Prediction of student achievement in school from longitudinal data, followed by deliberate manipulation of the environment and analysis of the consequences

*Source: J.I. Goodlad et al., Computers and Information Systems in Education; New York, Harcourt, Brace and World, Inc., 1966, pages 21–23.

BUDGET AND FINANCIAL SUPPORT		
Statistics on school costs broken into budgeted categories		
Maintenance of assessed evaluation statistics and data pertaining to proportion of district income spent on education	Relationships between financial support and various evidences of school productivity	Decisions pertaining to school bond referendums and building construction in relation to alternative predictions of population growth and financial support, together with calculations pertaining to how much new industry will be attracted by new and better schools
FACILITIES		
Cost statistics on all aspects of school construction and maintenance	Relationships between costs and various types of construction and costs of maintenance	Manipulation of facilities to test hypothesis growing out of observation at Level 2
CURRICULUM, INSTRUCTION, AND MATERIALS		
Number of students in various patterns of curriculum	Relationshps between student high school curricula and later academic and work careers	
Student responses on programmed lessons and courses	Relationships between responses and age, IQ, past achievement, etc.	Study of student learning styles and various provisions for them, such as different sizes and types of groups
Storage and retrieval of data on student assignment to individual instruction, large groups, small groups, etc.	Relationships between student assignment and various aspects of student success	Manipulation of the instructional-grouping environment to test hypothesis growing out of observations at Level 2

SEGMENT INTERACTIONS - OPTION B



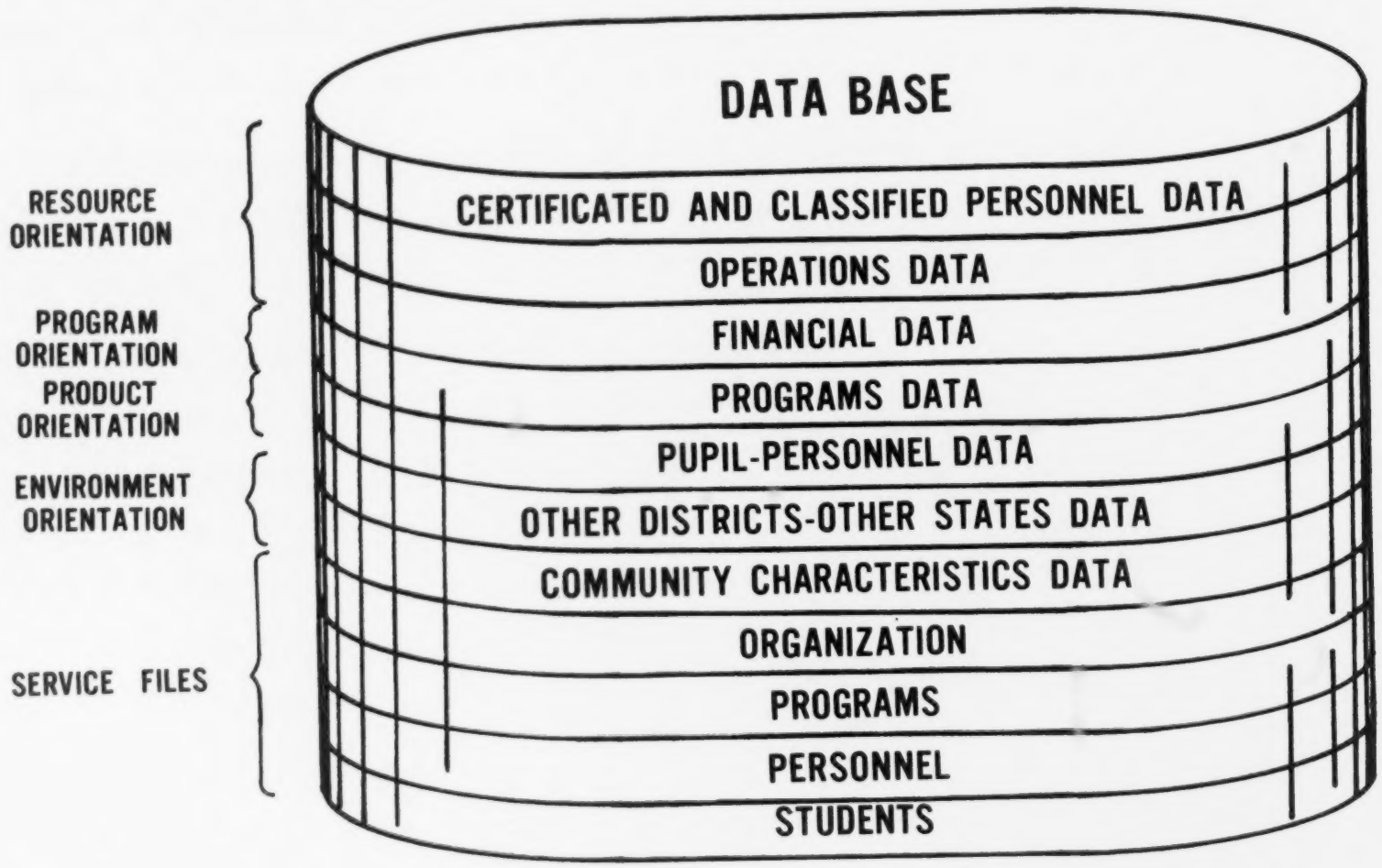
The above chart illustrates the interactions between the information system segments and the decision processes they model.

Planning proceeds within the guidelines provided by the policies and objectives established for the district. The main products of planning are decisions regarding what programs to undertake. (All other planning elements identified in the previous chart are, in a sense, supportive to decisions made for and about programs.) Next is the allocation and scheduling of resources required to implement these programs. Programs are then conducted, controlled, and evaluated. Simultaneously, individual pupil performance is evaluated and guidance provided as needed.

The point to be made is that even though the system may be implemented data processing application by data processing application and/or segment by segment, all parts must work together if the decision needs of the school district are to be met.

These concepts provide the basis for a discussion of the second dimension: the data base of the information system.

EXECUTIVE INFORMATION SYSTEMS	A SYSTEM FOR EDUCATIONAL ADMINISTRATION



The information system data base shown above is characterized in a functionally ideal sense: that is, it resides on a fast-response, direct access (random access disk) device. (In reality, the total data base would reside in a number of forms, ranging from digital storage on disks or tapes to words and numerals on hard copy.) The data base shown consists of seven logical data categories of files (with four orientations) plus four service files. A listing of the possible contents of the seven major data categories grouped according to the four orientations is provided on pages 35 through 37, inclusive.

The service files shown —— organization, programs, personnel and students —— are special index files that should be included in a highly automated system to ensure standardization of data inputs and outputs. To a large extent, the data in the service files will duplicate that contained in the other files. An employee's name, for example, can reside in many files, but its format (the way it appears) in the service file is considered to be correct for purposes of validation.

In general, the service files have two uses:

1. Data Screening — Edits and Controls. All data transactions "pass by" these files to assure the correct use of standard data elements such as employee name, employee number, and job assignment, and to assure the correct association of two or more data elements such as employee number with employee name.

2. Output Reporting. Certain information such as employee reporting names and program titles for output reports is extracted from these files to assure reporting consistency.

An important point to be made at this juncture is that we are not showing file design. For example, the listing on the following pages shows thirteen categories of data under the heading "Certificated and Classified Personnel." In designing a system, these categories would be regrouped into files whose structure would be based on considerations of information usage and equipment available for data processing. This may result in reducing the thirteen categories to, say, five files, as shown below.

File 1 Potential Employees (Applicants)

File 2 Educational Background and In-Service Training (Certificated)

File 3 Current General Personnel Data

File 4 Skills and Employment History

File 5 Terminated Employees

EDUCATIONAL ADMINISTRATION
DATA CATEGORIES

Resource Orientation	
A. CERTIFICATED AND CLASSIFIED PERSONNEL 1. Identification and Personal Data 2. Educational Data 3. Skills Data 4. Employment History 5. Salary History 6. Pre-Hire Information 7. Assignment Data 8. Personnel Function Activity 9. Past Employee Data 10. Salary and Benefits Data 11. In-Service Training Data 12. Test Data 13. Evaluations	B. OPERATIONS DATA 1. Purchasing 2. Supplies and Inventories 3. Maintenance Records 4. Cafeteria Operations 5. Library and Publications 6. Transportation C. FINANCIAL DATA 1. Budgets/Appropriations 2. Payroll 3. Accounts Payable 4. General Accounting

EDUCATIONAL ADMINISTRATION
DATA CATEGORIES (Continued)

Program Orientation	Product Orientation
D. PROGRAM DATA 1. Program Identification a. Course Identification b. Status (Experimental, Pilot, Standard) c. Effective Dates 2. Financial a. Budget b. Expenditures 3. Program Conduct a. Teacher(s) b. Students c. Materials d. School(s) 4. Program Evaluation	E. PUPIL-PERSONNEL DATA 1. Identification and Personal Data 2. School Data (Including Grades and Test Scores) 3. Family and Home Data 4. Educational and Mental Development 5. Emotional Development and Attitudes 6. Social Development and Attitudes 7. Health and Physical Development 8. School Experiences and Plans 9. Special Activities and Interests 10. Current Educational Activities 11. Administrative Data 12. Attendance

EDUCATIONAL ADMINISTRATION
DATA CATEGORIES (Concluded)

Environmental Orientation
F. OTHER DISTRICTS, OTHER STATES DATA 1. Programs 2. Pupils 3. Financial 4. Facilities 5. Personnel 6. Transportation
G. COMMUNITY CHARACTERISTICS 1. Identification Data a. Grid, Political, Geographic, Postal, Administrative, Zoning, Streets, etc. 2. Facilities and Services a. Recreational, Cultural, Law Enforcement, Fire Protection, Health/Welfare Facilities, Transportation 3. Socio-economic Characteristics a. Property Values, Dwelling Types, Police Information, Neighborhood Characteristics, Occupational Groups, Welfare Data

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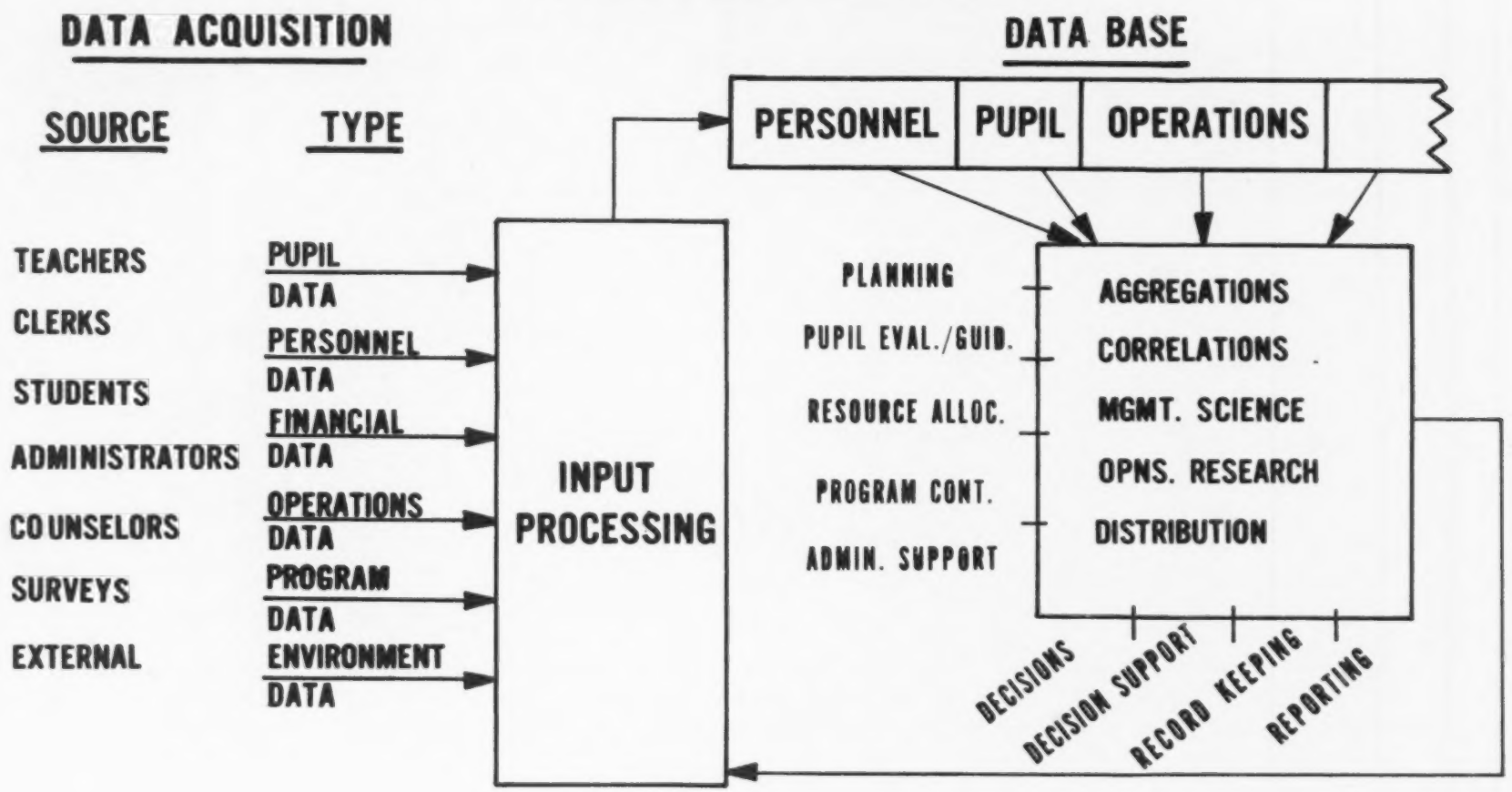
EXECUTIVE INFORMATION SYSTEMS	A SYSTEM FOR EDUCATIONAL ADMINISTRATION

INFORMATION FLOW



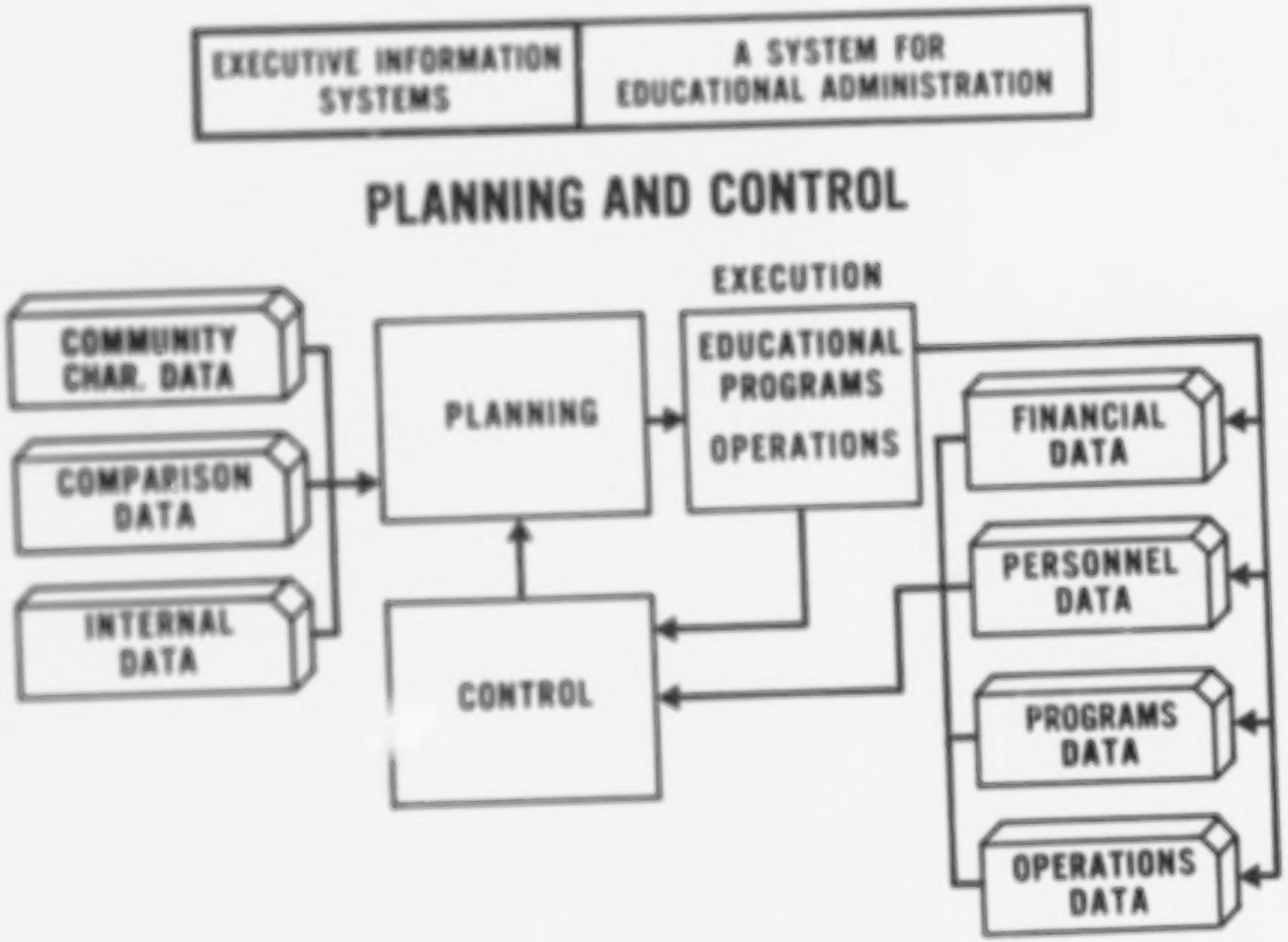
We have covered the first two information system dimensions, system segments and data base. The third dimension, information flow, will be discussed in terms of the system processing environment (above chart) and then from a management operations environment perspective.

Information flow represents a dynamic aspect of information systems. As shown above, various types of data provided by various sources enter the centralized processing portion of the system via an activity referred to here as input processing. This activity could range from the translation of source data into machine-readable form, to a wide variety of data edit and control tasks for quality assurance, to programmed decisions regarding the file in which to store a given element of data.

In this process the service files can be put to a very good use. A service file on personnel, for example, can serve as a very good screen to prevent erroneous data, say, a transaction on a non-existent employee, from entering the data base. Service files can also be used to add certain data to a transaction. A data transaction on an employee, for example, can be entered with the employee number while the name or number of the employee's department can be added by the service file.

Following input processing, the data are stored in the various files, for example, personnel files, of the data base. A key system processing feature is its ability to extract data from the files and prepare it – for example, compile aggregations – for use by district management in the functions of planning, pupil

evaluation and guidance, and so on. In general, it can be asserted that the information will be used to make decisions, as support or back-up to decisions, for record keeping and later referral, and for reporting to others. In preparing the data for use, the system performs a number of data preparation tasks (output processing), ranging from simple aggregation, to correlation analyses and more complex management science routines and, finally, distributes the data. The importance of recognizing the distribution function in a large geographically dispersed district cannot be overemphasized. The process of getting regular monthly reports to district personnel, unless it is carefully planned, can become very cumbersome, expensive and time consuming.


EXECUTIVE INFORMATION SYSTEMS
A SYSTEM FOR EDUCATIONAL ADMINISTRATION
PLANNING AND CONTROL
EXECUTION
COMMUNITY CHAR. DATA
COMPARISON DATA
INTERNAL DATA
PLANNING
CONTROL
EDUCATIONAL PROGRAMS
OPERATIONS
FINANCIAL DATA
PERSONNEL DATA
PROGRAMS DATA
OPERATIONS DATA

The facing chart depicts the second view of information flow: the management operations environment context. Three categories of data are shown as inputs to the district planning process: community characteristics, comparison, and internal. The first refers to the school district environment (external to the schools in the district but bounded by the district); the second to data from and about other school districts; and the third to the data base maintained on the school system within the district itself. The information contained in the data outputs will assist the planners in deciding what educational programs are to be undertaken and how the district operations are to be conducted. The execution of these programs and operations results in events, and data are collected on these events. For example, money is spent, personnel are hired and promoted, and programs and operations produce results. Data on these events are fed by the system to the control function and, based on these data, plans are revised to improve over-all effectiveness.

Some interesting points can be made about the differences between planning information and control information. First, planning information transcends organizational boundaries within the district. Plans are developed to erect facilities, to undertake programs, and to prepare for so many students next year. Because control is aligned with the organizational structure and implemented through individual responsibility, control information relates to a specific organizational element. Second, planning information focuses on trends over long time periods, whereas control information deals with relatively short time periods. Finally, planning information is general, whereas information for control is specific.

With this discussion on information flows we have covered the three dimensions of an information system. Now we would like to discuss some of the important characteristics of an integrated system.

EXECUTIVE INFORMATION SYSTEMS	A SYSTEM FOR EDUCATIONAL ADMINISTRATION

INTEGRATED SYSTEM CHARACTERISTICS

1. MASTER PLAN - EVOLUTIONARY GROWTH
2. FORMAL DATA ACQUISITION
3. STRUCTURED DATA BASE & CONTROLS
4. CONSOLIDATED PROCESSING
5. NON-STANDARD DATA RETRIEVAL
6. INTERRELATABILITY OF DATA
7. ADMINISTRATOR'S ENVIRONMENT
8. INTEGRATED PLANNING AND CONTROL

Before a strategy for system improvement can be evolved, it is necessary to identify the major characteristics of what we have referred to here as a larger or integrated view of the district's information system. They are listed in the opposite chart and are briefly discussed below.

1. Master Plan – Evolutionary Growth: The master plan for the school district's information system must reflect the basic goals and philosophy of the master plan for the district itself. It must reflect awareness of the characteristics of both the school district's organization and the community, and provide evaluation criteria and operational concepts. Finally, a time-phased schedule for system implementation must be included.

2. Formal Data Acquisition: Most data acquisition schemes consist of a set of haphazard, intermittent, ill-defined procedures. In contrast, the data acquisition procedures for an integrated information system must be one of the most carefully designed and monitored functions. It is formal, well documented, and continuous in nature with fixed personal responsibilities.

3. Structured Data Base and Controls: Each data element has a specific home in a specific record in a specific file. Everyone involved must comprehend this overall structure, be aware of the data controls, understand who has access to what

data, and what procedures are necessary to make changes. (See also discussion on Data Base.)

4. Consolidated Processing: In an integrated system, similar operations are efficiently combined, such as combining file update processes or report writing processes.

5. Non-Standard Data Retrieval: Probably one of the most important capabilities required in a formal information system is that of satisfying unexpected demands in a reasonable time at reasonable cost. It is impossible to specify all the information needs prior to system implementation. The way in which the system deals with this problem can be quite elementary, such as having a programmer write each request as a special computer program; or complex, such as having pre-programmed data management packages that permit a data request to be directly translated into machine instructions.

6. Interrelatability of Data: Basically, the ability to interrelate data depends on the establishment of data standards. In an integrated system, data files are viewed as integral parts of the over-all system and not just parts of one application or one use. If a five-digit code is used in one place to identify employees, the identical code is used in all places to identify employees.

7. Administrator's Environment: Probably one of the most important criteria for system success (use in day-to-day management) is its usefulness to the educational administrator. To this end the system must be relevant to the executive's decision processes and be built upon explicit models provided and understood by the executive himself. It must be the executive's system, not the analyst's system.

8. Integrated Planning and Control: The system is designed to permit the outputs of (information and subsequent actions relevant to) planning to directly affect operations, and operations to generate information which affects evaluation and control. Feedback from control, in turn, may serve as the basis for replanning.

It is important that these characteristics be explicitly addressed in any system design efforts because each contributes to the effective operation of an economically feasible system.

EXECUTIVE INFORMATION SYSTEMS	A SYSTEM FOR EDUCATIONAL ADMINISTRATION

SELECTION OF STRATEGY

WHAT LEVEL OF EFFORT?

WHAT PROBLEMS ARE MOST PRESSING?

PAYOFF vs. TIME TRADEOFFS

WHAT ABOUT CURRENT APPLICATIONS?

WHOSE COMPUTING FACILITIES?

PRIORITIES?

Having described the educational administrator's information system in his terms, i.e., individual data processing applications, and having established a larger context for viewing his system, we can now identify an approach to selecting a strategy for system improvement.

The above chart lists some of the questions that must be answered before an improvement strategy can be defined. Other factors about which relevant questions must be asked are listed below.

- The Political Climate: Are the people that are involved, i.e., potential users, ready for a prolonged system development program? Is their organization geared for an analysis and design program? Should they wait until others have paved the way?

- Funds Available: How much can we afford to earmark for information systems improvement?

- Personnel Available: Can we attract and retain good systems people?
- Outside Support Services: What kinds of professional and equipment support services are needed? Where can they be obtained?
- Technology: Do we know the practical state-of-the-art being applied by others in a comparable environment? The payoffs for being first are small, the risks are high.

In theory, there is an exceedingly large number of possible strategies. Generally, a given strategy is determined by functions or system segments, discussed earlier, to be included in the information system, the organizational levels to be served by the information system, and the level of system sophistication. The latter is measured by several factors that characterize

system design: hardware, software, problems addressed, techniques, and procedures.

Regardless of strategy, the educational administrator must involve himself with a maze of details. Two preliminary steps the administration should face is establishing the organizational arrangements which assure that the systems people will have the necessary perspective to get the job done and directing the development of an information system master plan.

EXECUTIVE INFORMATION SYSTEMS	A SYSTEM FOR EDUCATIONAL ADMINISTRATION

PROBLEMS

INFORMATION SYSTEM

INFORMATION HANDLING PROCESSES

DATA BASES

DATA RETRIEVAL AND REPORTING

GENERAL EXECUTIVE INDICATORS

PLANNING PROBLEMS

RESPONSIBILITY ASSIGNMENTS

TIME SPENT ON DETAILS

The categories of problems listed in the opposite chart are associated with the educational administrator's current system. Most of these problems are common to systems built upon early data processing concepts. The additional breakout shown below can serve as a guideline in helping the educational administrator determine the nature of the problems associated with his current system.

Inefficient Information Handling Processes

- few standard procedures to guide personnel and assure consistency
- needless duplication of files and outputs
- high dependency on a few key clerical level personnel
- high degree of manual processing interspersed between automated steps

Inadequate Organization of Data Base

- data acquisition: redundant and costly
- data acquired and entered in non-standard form

Inadequate Data Retrieval and Reporting

- incomplete information – need for manual processing before use
- reporting delays
- poor identification of who is supposed to get what information
- improper matching of reports with organizational responsibilities

General Executive Problems

- absence of trend information and projections
- poor planning information – no environmental data
- difficulty in setting priorities
- lack of clearly defined responsibilities
- high cost of planning iteration
- inordinate amount of executive time spent on administrative details

In general, the extent to which the educational administrator focuses on an integrated view of his information system has a significant bearing on the reduction of these problems.

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In the last analysis an (management) information system must be an integral part of the over-all process of management. It must be a part of a larger management system. Certainly this was alluded to earlier in disucssing system segments, information flows, and planning and control systems. The discussion on this and subsequent pages carried out the third purpose of this report: to provide an example of a structured reporting system which can be viewed as a part of a management control system.

The management system addressed involves budgeting for the various educational and support activities of the district and controlling the expenditure of resources. Both programs (what the district is doing) and organizational units (resource centers) are considered. In this context a program is defined as a set of activities directed at a given objective — or set of highly interrelated objectives — for which responsibility (usually) can be pinpointed. If the district is employing a program budgeting system, there would be a definite relationship between these responsibility-centered programs and the budgeting structure. Although this point is extremely important in designing a given system, it will not be discussed further here.

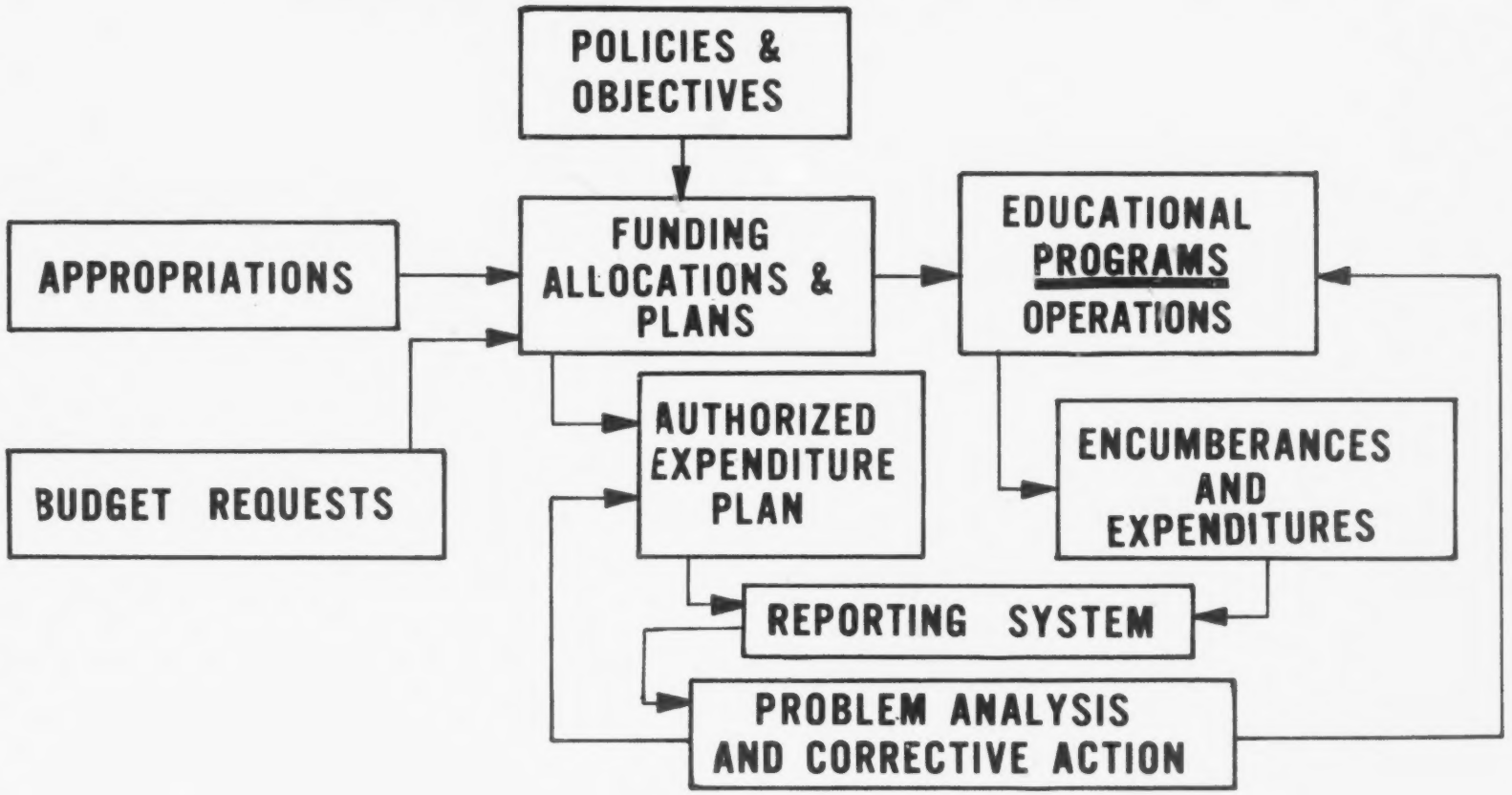
Organizational units are "homes" for people and for functional capabilities. They represent potential. People, for example, are identified with organizational units, and their efforts are

delivered to programs. In some cases a program may be coterminous with an organizational unit, and that unit's manager also may be the program manager. Other organizational unit managers may serve as managers responsible for creating a capability for delivery to programs.

Assume that the district wants to evaluate activities (programs) and organizational units (groups of people and facilities), and that the dollar (cost) is an important measure for evaluation and control. The next few charts illustrate a structured reporting system which addresses the basic cost control needs of the management of the district.

EXECUTIVE INFORMATION SYSTEMS | A SYSTEM FOR EDUCATIONAL ADMINISTRATION

RESPONSIBILITY ACCOUNTING SYSTEM



The above flow diagram sets the context within which the responsibility accounting system operates. The amount of funds available (appropriations), the district's policies and objectives, and the individual budget requests for funds influence the way in which funding allocations will be made. These monies are allocated to educational programs and district operations, and an authorized expenditure plan (a budget) for each program and each operational element is formulated.

As the programs and operations are conducted, money is spent (encumbrances and expenditures are created). Records of these expenditures, along with the expenditure plan, constitute the prime inputs to the responsibility accounting system. This system then associates these records with the proper (program and/or operation) account, allocates certain support accounts to direct-program accounts, associates these with the budget accounts, and prints out the reports. These reports are used for problem analysis and formulation of the necessary corrective actions (feedback), such as adjusting either the budget or the program operation.

The next chart emphasizes three important system features: the budget, the expenditures, and the reporting system.

EXECUTIVE INFORMATION SYSTEMS	A SYSTEM FOR EDUCATIONAL ADMINISTRATION

SYSTEM CHARACTERISTICS

AUTHORIZED EXPENDITURE PLAN-BUDGET

- PROGRAM FOCUSED
- TIME PHASED-MONTHLY
- TYPE EXPENDITURE
- ORGANIZATION SUMMARIES
- CONTROL ORIENTED

EXPENDITURES

FOR EACH EXPENDITURE RECORD:

- TYPE
- PROGRAM AND/OR ORGANIZATION
- DATE
- AMOUNT
- ENCUMBERANCE OR EXPENDITURE

REPORTING SYSTEM

- MONTHLY CYCLE
- HIERARCHICAL REPORTING
- VARIANCE COMPUTATIONS
- CURRENT MONTH-YEAR-TO-DATE-YEAR-END FORECAST

Budget Characteristics: The most important feature of the budget is that it is program-focused, that is, the budget is structured in accordance with the various objectives of the school district. Certain District-level support organizations such as General Administration can be treated as programs or, as an alternative, their costs can be allocated to programs on some equitable basis. The budget is time-phased: it is subdivided into twelve monthly budget estimates. The types of expenditures – salaries, supplies, travel, and, in the case of personnel, their organizational units, are identified. (This approach assumes that a program can cut across organizational units.) These characteristics create a budget which is control-oriented – it includes all the necessary information for management control.

Expenditure Information: Since expenditure information must later be directly related to the budget, its dimensions must be the same as the budget. Each expenditure transaction must indicate the type, program and/or organizational unit, date, amount, and whether it is an expenditure, or an encumbrance to be expensed later.

Reporting System: As noted before, the role of the reporting system is to:

- collect records of expenses,
- associate these records with the proper accounts
- perform allocations and accumulations,
- relate the accounts with budget accounts, and
- create management reports.

Since the budget information is provided in monthly units, this reporting system will have a monthly cycle, computing variances (budget versus actual) for the current month activity, for the year-to-date activity, and for the expected (forecasted) activity for the year.

EXECUTIVE INFORMATION SYSTEMS	A SYSTEM FOR EDUCATIONAL ADMINISTRATION

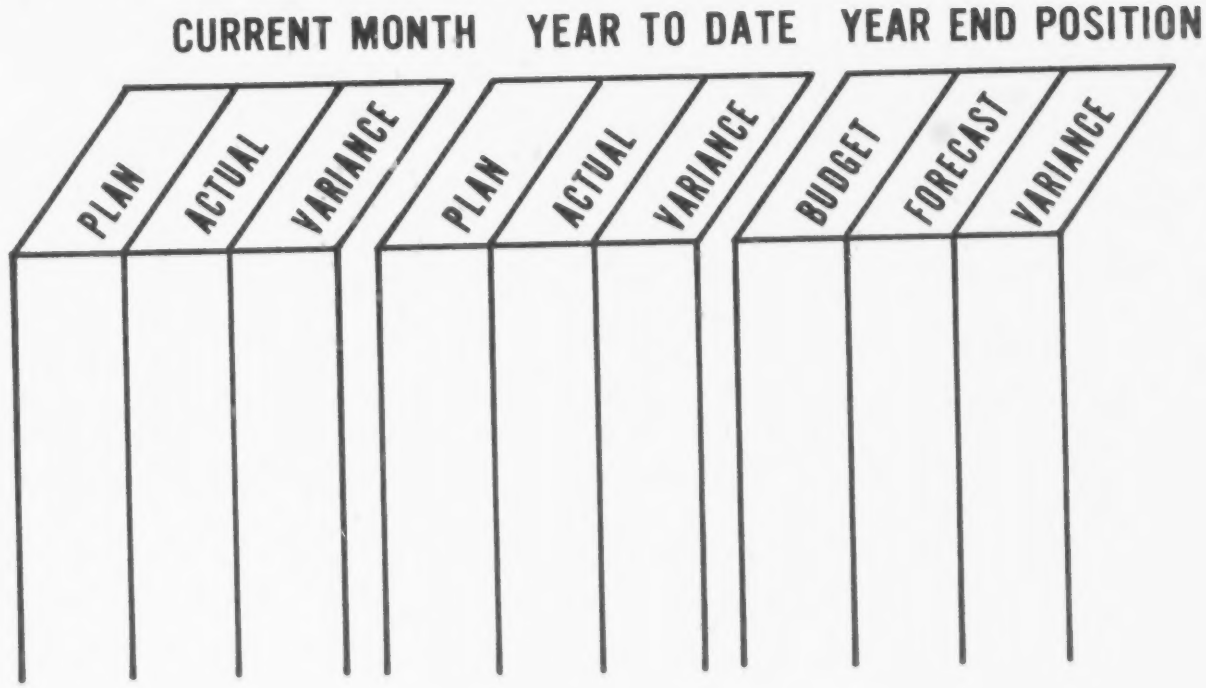
FORMAT OF REPORT

POSSIBLE SUBJECTS

1. DISTRICT TOTAL
2. PROGRAM-DISTRICT LEVEL
3. DISTRICT ORGANIZATION
4. SCHOOL
5. PROGRAM-SCHOOL LEVEL

POSSIBLE OBJECTS OF INTEREST

1. ORGANIZATIONS
   - SCHOOLS
   - SUPPORT
2. EXPENDITURE TYPES
3. PROGRAMS



The opposite chart illustrates the format of the system output (reports). Regardless of subject, intended user, or focus (program or organizational unit), the format does not vary. Information on the current month, the year-to-date, and a forecasted position at the year's end is included. For each of these three time slices the report provides the budget, the actual expenditures, and a variance calculation. It is important to remember that the district administrators, at all responsibility levels, reside in a hierarchy, and that control reports should be tailored to their needs at each level in the hierarchy.

Five possible report subjects, coverage, or scope are identified. If the subject of the report is District Total, the contents would treat the district in its entirely and be of interest to the Superintendent. A report on Program-District Level would summarize the information on a certain program in all those schools of the district implementing it. The District Organization report would address such district organizational units as general administration and purchasing. The School report would address each school in the district individually, and the Program-School Level report would cover each program at each school individually.

Each of these five possible report subjects has three possible objects of interest or breakouts. In the case of the District Total report for the superintendent, the report is broken-out by organizational units, by expenditure types and by programs. In the responsibility accounting system it would be possible to break-out each of the other four report subjects by each of these three objects of interest, giving a maximum of fifteen different report types. It will be shown that only eight of these have utility.

EXECUTIVE INFORMATION SYSTEMS	A SYSTEM FOR EDUCATIONAL ADMINISTRATION

OBJECTS OF INTEREST

ORGANIZATIONS

SCHOOLS
- SCHOOL A
- SCHOOL B

SUPPORT
- GENERAL ADMIN.
- CONTROLLER
- FOOD SERVICES
- TRANSPORTATION
- PLANT MAINT.
- PURCHASING
- OTHERS

EXPENDITURE TYPES

- SALARIES CERTIFICATED
- SALARIES CLASSIFIED
- SUPPLIES
- BOOKS
- EQUIPMENT
- PERSONNEL TRAVEL
- TRANSPORTATION
- OTHER SERVICES
- OTHERS

PROGRAMS (UNDER MAJOR GROUPING)

- ART
- ENGLISH
- SHOP

- TITLE II SCH. LIB.
- VOC. ED.
- SCHOOL LUNCH

- DRIVER EDUCATION
- PHYSICALLY HAND.

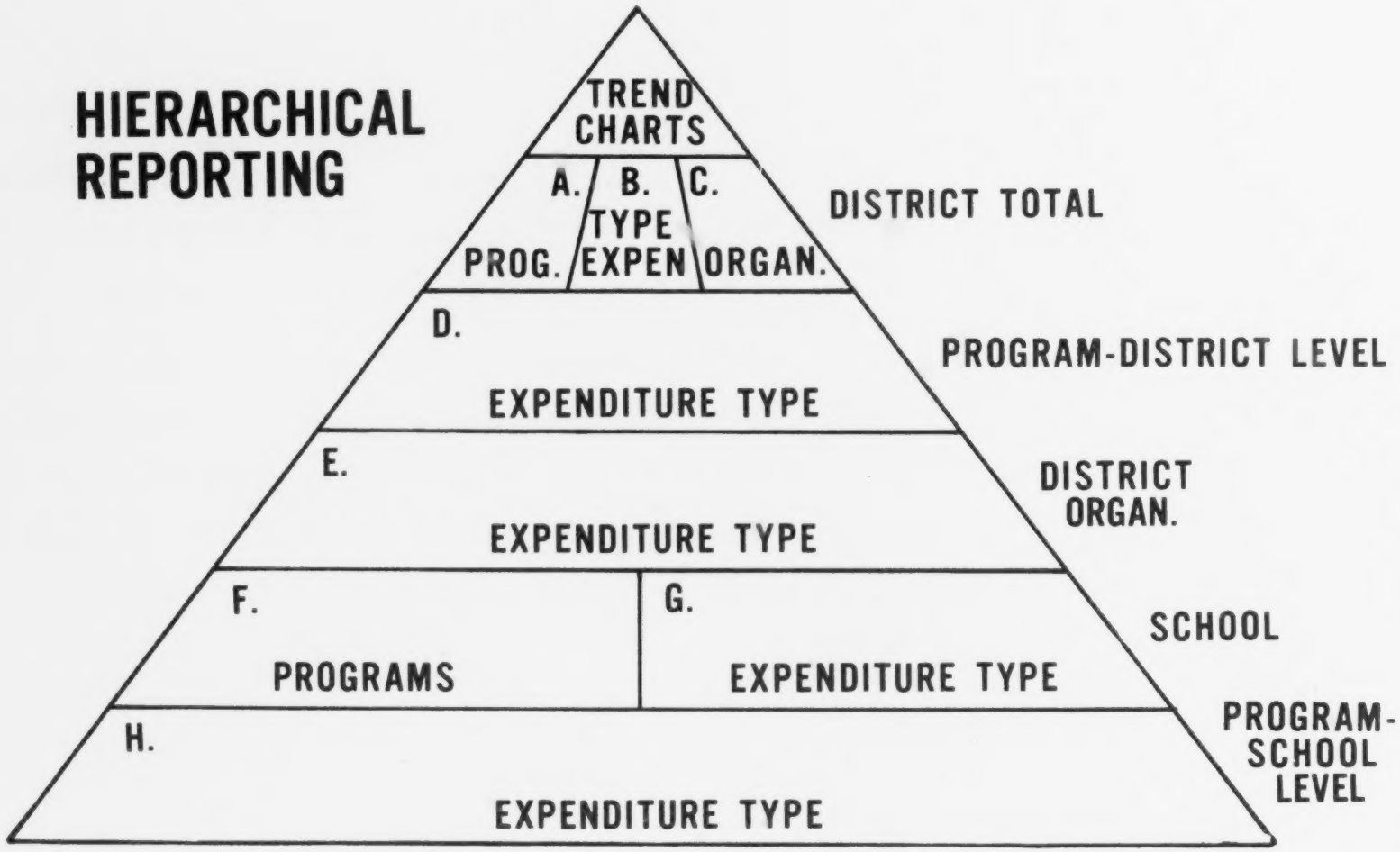
- SWIMMING POOL
- OTHERS

The opposite chart details the three objects of interest. Note that under the heading Organizations, two categories appear: School and Support. A school is a district organizational unit, and the school, in turn, can be further subdivided into lower-level organizational units. The Support category entries identify the types of non-teaching services and functions necessary to carry out the operations of a school district.

The Expenditure Types category is typical of traditional budget systems. Within some form of structure, Programs represent the lowest level of activities at which responsibility assignment is meaningful.

EXECUTIVE INFORMATION SYSTEMS	A SYSTEM FOR EDUCATIONAL ADMINISTRATION

HIERARCHICAL REPORTING



It was shown earlier that the responsibility accounting system can produce fifteen report types, based on five subjects and three objects of interest. As shown above, only eight report types (A through H) are required to provide the necessary cost control information to all management levels in the district.

The five report subjects are assigned to levels in a hierarchical structure. The objects of interest are given in the triangle. A report of type F, for example, would be prepared for each school in the district (subject) and it would present the cost control information (in the report format shown earlier) for each program in that school (object of interest). Only one each of report types A, B, and C would be prepared, each depicting the entire district's activities in a single report (perhaps on a single page), in each case by program by expenditure type, and by organizational unit (including individual schools as organizational units).

It is possible that one or two additional reports might be desired.

Report No.	Subject	Object of Interest
I	School	Organization
J	Program-School Level	Organization

Both would be necessary if the "management system" of the district established programs that crossed organizational unit boundaries and permitted "cross-charging." Thus, an individual in a given organizational unit could officially support (work on) and account for his time on a program that is the responsibility of another organizational unit. For example, the plan and budget for the art program may specify that the services of the athletic coach are required a few days every month. The system would account for the coach's salary and other direct costs for those days on the art program.

The apex of the triangle shows that certain trend charts, reflecting the interests of the administrators, would be prepared (in any number) to supplement the other reports. The format of the trend charts could consist of a plot of budget versus actual expenditures for each month throughout the year. Or it could be just a plot of the variance. Information of interest could be the monthly variance of certain major programs, of each school, and of certain organizational units such as transportation or personnel. If these are being prepared manually, their number has to be kept small since their preparation can become quite a chore.

A reporting system such as this is not easy to obtain. In fact, it is based on elaborate processes of cost collection (data acquisition) processing and storage. It can, however, serve as a model for understanding what a structured reporting system could do and for identifying some of the information requirements of educational administrators.